TRC

Results you can rely on

STATEMENT OF QUALIFICATIONS

Metals Treatment Technology

Table of Contents

Section 1 Metals Treatment Overview 1

Section 2 Metals Remediation Services and Experience 5

Section 3 In-Plant Treatment of Industrial Waste 15

Section 4 Remediation Examples for Specific Metals 18

Metals Treatment Technology

SECTION 1

Metals TREATMENT Overview

TRC (formerly RMT)* has developed a number of treatment chemistries for different metals. Our approach is to tailor the treatment process to the contaminant and disposal environment at hand by converting the contaminant into a form that is stable and nonleachable, both in the regulatory leaching tests and in the environment. We have partnered with several chemical suppliers to supply the treatment reagents. One supplier is Premier Chemicals, who markets the treatment reagents under the trade name "EnviroBlend®". The TRC treatment process is versatile, cost effective, environmentally sound over the long term, and widely accepted by regulatory agencies.

TRC treatment reagents effectively treat the following:

- Arsenic
- Antimony
- Barium
- Cadmium
- Chromium
- Copper
- Lead
- Mercury
- Nickel
- Selenium
- Zinc

TRC's treatment chemistries have been recognized in a number of U.S. patents.

Applications

Remediation. TRC's treatment chemicals can be mixed with metal-bearing material either in-place or when the material is excavated. The stable, treated material can often then be left on-site or disposed at a nonhazardous waste landfill. TRC's technology has effectively treated over 100 waste streams at over 50 sites in the United States and abroad.

In-Plant Industrial Waste. The additives can also be mixed with the process stream to stabilize heavy metals, generally before a hazardous waste is generated. The process is typically *exempt* from RCRA permitting, and the resulting material can be disposed at a nonhazardous waste landfill. The technology has been successfully implemented at over 40 metals facilities across the United States.

Benefits

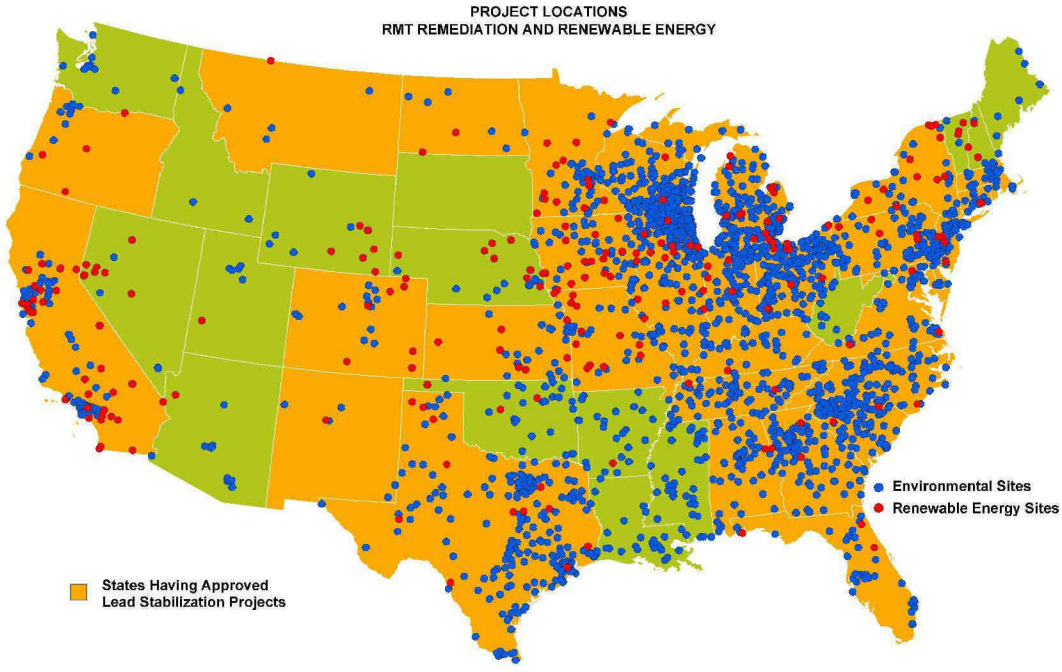
Cost-Effective. TRC's technology is more cost-effective than conventional solidification/stabilization techniques. It requires less treatment chemical, which reduces bulking and results in lower disposal costs. It is also easier to apply, and typically avoids the transactional costs and time associated with RCRA permitting.

Environmentally Sound. TRC's technology treats metal-bearing wastes to limit metal leaching in tests and, more importantly, in the environment. In many cases, the treated material can remain on-site. Treated materials pass the USEPA's Multiple Extraction Procedure (MEP), which was designed to simulate 1,000 years of leaching.

Widely Accepted. TRC's metals treatment technology has been widely accepted by regulatory agencies throughout the country. It has been implemented under various regulatory programs, such as CERCLA and RCRA, and many state programs. Although the USEPA cannot endorse specific processes, TRC's technology is routinely accepted by the USEPA and state agencies as a viable treatment method.

*The Environmental Business Unit of RMT was acquired by TRC in June 2011.

A map illustrating TRC's extensive lead stabilization and general remediation experience is provided below.



Versatile. Because TRC's treatment process stabilizes wastes over a wide pH range, the risk of leaching over the long term is minimized. As a result, it satisfies a variety of regulatory requirements in the United States and abroad.

Chemistry

TRC's Applied Chemistry team is unique in its approach to developing site-specific stabilization chemistries for all RCRA metals as well as the additional metals listed in the Phase IV Land Disposal Regulations. Relying on the resources of TRC's state-of- the-art Applied Chemistry laboratory, the TRC metals treatment team has developed stabilization approaches that convert metals to forms that do not leach in either the environment or regulatory tests. With an understanding of the potential for both short- and long-term stability within specific treatment scenarios, TRC's skilled chemists provide solutions that balance environmental protection, health and safety, and cost-effectiveness.

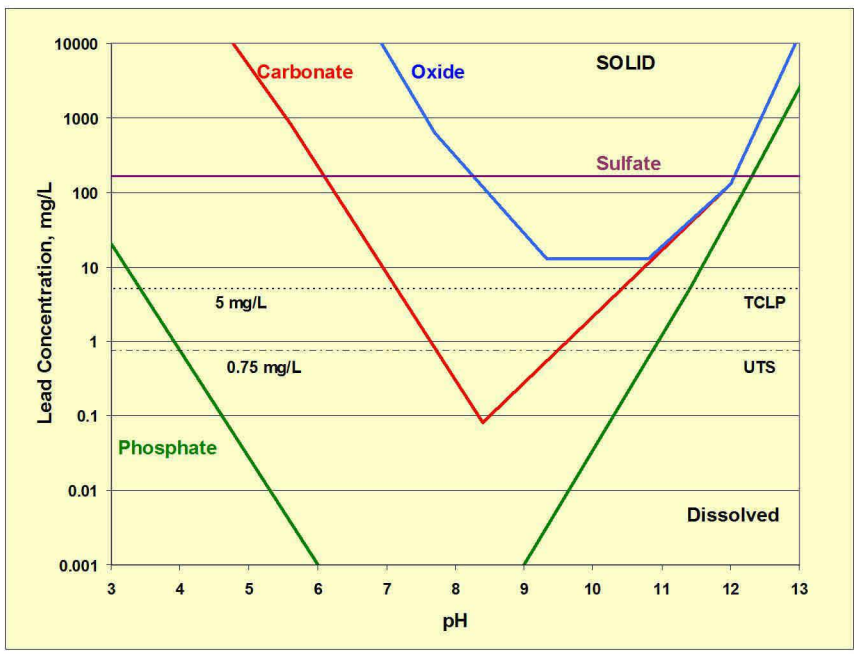
Different metals require different treatment chemistries. To illustrate our approach, we can look at lead. Lead is one of the most frequently encountered metal contaminants of concern. However, it is typically treated with a focus on passing the TCLP test only. TRC offers a different approach. Understanding that the solubility of lead is pH-dependent (Figure 1), and that lead phosphate compounds are very stable, TRC's treatment forms lead phosphates while buffering pH in the range of 6 to 10. This

combination of treatment goals ensures that the lead will remain in a stable form for a long time. In fact, the lead compounds formed generally become even more stable over time. Another commonly found contaminant is arsenic, which is treated by adding iron-based reagents to form insoluble iron arsenic species.

The treatment reagent is added to the waste matrix with simple mixing techniques. Because the treatment reagent is specifically formulated for the waste being treated, chemical dosage rates remain comparatively low, compared with conventional treatments such as Portland Cement or lime. Furthermore, because our goal is to modify the nature of the waste matrix chemically, and not to simply form a hardened mass, no addition of water is required. The result is significantly lower bulking and lower transportation and disposal costs.

Figure 1

Solubility of Lead Species as a Function of pH



Comparison with Conventional Chemistries

Dosage rates for stabilizing soil with Portland Cement and lime generally lie in the 10 percent to 20 percent range. With the TRC reagent, soil is typically stabilized with dosages of less than 5 percent. For industrial wastes, where cement dosages may be as high as 30 percent, the reagent is typically effective at dosage rates of 2.5 percent to 10 percent. Besides providing for a more cost-effective stabilization, the reagent provides

for a more sound stabilization chemistry than lime or Portland Cement. Because these lime-based reagents contain highly alkaline material, they raise the pH of water to values in excess of 12. So, even though they can "treat" wastes by neutralizing the acid in the TCLP and meet a regulatory criterion, they can mobilize lead in treated wastes that contact rainwater or groundwater. With the reagent, the lead remains stable under all reasonable leaching scenarios. Table 1 shows the superior performance of TRC's treatment reagent compared to conventional treatment methods.

Table 1

Treatment of a TCLP-Hazardous Metal Processing Waste

	TCLP (Acid) Leach Test		Hazardous Waste Criterion (mg/L)	SPLP Acid Rain (Water) Test	
	Lead (mg/L)	Final pHf		Lead (mg/L)	Final pHf
Untreated	600	6.0	5.0	<0.003	8.2
Lime (Calcium Hydroxide) (% by weight)					
+5%	76	6.5	5.0	290	12.2
+10%	0.2	8.6	5.0	540	12.5
+15%	6.2	10.4	5.0	510	12.5
Portland Cement (% by weight)					
+5%	450	5.3	5.0	19	11.5
+15%	< 0.2	10.4	5.0	11	11.9
+25%	1.2	11.6	5.0	12	11.9
+50%	10.0	12.0	5.0	3.0	12.1
TRC Reagent (% by weight)					
+4%	2.4	5.8	5.0	<0.003	10.6
+6%	0.4	5.5	5.0	<0.003	10.3
+8%	< 0.2	5.6	5.0	<0.003	8.5

Note: All samples were crushed to pass a 9.5-mm sieve per Method 1311 Toxicity Characteristic Leaching Procedure, 40 CFR, Part 261, Appendix II

TRC's patented treatment technologies have successfully treated hundreds of heavy metals-impacted sites.

SECTION 2

Metals Remediation Services and Experience

Effective remediation requires the ability to characterize site conditions using a combination of tools. Proper sampling, understanding metals chemistry, properly performing treatability tests, data interpretation, and modeling are critical to identifying the most cost-effective remediation approach. Addressing impacted sites in the most cost-effective manner can save millions in remediation dollars. TRC applies a solution-focused approach to hazardous substance site remediation projects. This involves the upfront integration of risk evaluation, long-term land use preferences, and overall site objectives into the remedial approach.

TRC has extensive knowledge of fate and transport of heavy metal contamination, as well as remedial action know-how. TRC will systematically and objectively evaluate all feasible commercially available treatment technologies. In addition, our scientists have spent years developing cost-effective means for rendering heavy metal contaminants nonhazardous. This research has resulted in a number of patented products that have been widely applied to heavy metal remediation sites across the country.

Regulatory Acceptance

As mentioned previously, TRC's treatment chemistries have been widely accepted by regulatory agencies throughout the country. They have been implemented under various regulatory programs, including CERCLA, RCRA, and a wide variety of state programs. TRC's treatment chemistries are stable over a wide pH range, allowing it to satisfy a variety of regulatory requirements in other countries.

Significant Cost Savings

When total costs are compared, TRC's stabilization process provides several significant financial advantages over solidification or other stabilization methods.

Lower Bulking Rates. The treatment additives are typically added at rates of 1 percent to 10 percent by weight. In contrast, solidification additives are typically added at rates of 10 percent to 50 percent, and can be as high as 200 percent. The higher bulking rates translate into proportionately higher transportation and disposal costs. Table 2 illustrates the treatment's cost effectiveness on a typical remediation project.

Table 2

	Price of Chemical ($/ton)[1]		Dosage (% by weight)[2]		Cost of Chemicals (per ton of soil)		Tons Disposed[3]		Total Transportation and Disposal Cost
TRC Reagent	$360	x	5%	=	10,500	x	$30/ton	=	**$315,000**
Portland Cement	$120	x	15%	=	11,500	x	$30/ton	=	**$345,000**
Fly Ash	$60	x	30%	=	13,000	x	$30/ton	=	**$390,000**

Notes:
1. The price and dosage of chemicals varies depending on the material to be treated, the specific chemical used, the site location, and the quantity of chemical.
2. Assumes 10,000 tons of untreated material.
3. Transportation and disposal costs vary. $30 per ton is typical cost.

EnviroBlend® can be mixed with conventional construction equipment.

Easier Chemical Application. TRC's treatment reagent application costs are generally about half the cost of solidification. Solidification chemicals usually consist of a fine powder with a high pH. A pugmill or other enclosed structure is typically required to control dusting and provide adequate mixing. The equipment has relatively high mobilization and operating costs, and reprocessing the solidified material is difficult. In contrast, the TRC reagents can be mixed in a wide variety of ways, including excavators, discs, dredging equipment, specialized mixing equipment, composters, and pugmills. The chemicals can be sized or wetted to control dusting, and the near-neutral pH reduces exposure concerns. All of this leads to higher throughput at lower daily costs.

May Avoid RCRA Permitting. With TRC's treatment technology, it is generally possible to stabilize the material in-place and then excavate the material and manage it as a non-hazardous solid waste, thereby avoiding the RCRA permitting process. In contrast, many of the conventional treatment methods require excavation of the waste, which may trigger RCRA hazardous waste regulations. The consequent restrictions preclude cost-effective on-site treatment.

Environmentally Sound Solution

TRC's applied chemists provide prompt results to expedite project execution.

Wastes treated with the TRC treatment reagent are stable over a wide pH range, so that they will not leach in common verification tests or, more importantly, in the environment. Therefore, there is little risk of metals leaching over the long term and, in some cases, the waste can be disposed on-site. Treated materials consistently pass the USEPA's Multiple Extraction Procedure (MEP), a test that was designed to simulate 1,000 years of leaching. There are many tests to predict leaching characteristics in various settings. For example, the TCLP test was designed to predict leaching in a municipal landfill. Although the hazardous waste regulations were developed based on this disposal scenario, it is often not realistic and, in some cases, could lead to a treatment solution that is not protective of the environment. A variety of other leaching tests have

been developed to simulate more realistic disposal settings, including the Synthetic Precipitation Leaching Procedure (SPLP), commonly called the "acid rain" test.

Many conventional treatments used for lead involve mixing a high pH, lime-based chemical, such as cement, with waste. During the test, the lime-based chemical neutralizes the TCLP's acidic leaching solution, and the lead does not leach appreciably. However, the same waste will likely leach significantly in neutral water leaching tests and in the environment. Material treated with lime-based chemical may then pose a greater environmental threat than it did prior to treatment. This concern is understood and recognized by the USEPA and various state agencies.

TRC Services

The phrase "from beaker to backhoe"™ best describes TRC's ability to provide comprehensive remediation services tailored to specific client needs. From laboratory based testing and analyses to engineering design and construction management, TRC can determine treatment parameters, gain regulatory support, and implement the solution in the field.

Treatability Studies. Our in-house Applied Chemistry Laboratory provides prompt results to expedite project execution. Our staff can perform bench- and pilot-scale testing to determine treatment parameters.

Turnkey Full-Scale Remediation. TRC provides all construction management services necessary to perform a turnkey remediation, resulting in regulatory closure and a restored site. TRC's experienced construction managers and field staff have built a strong reputation for providing quality submittals, meeting schedules, and executing work.

Chemical Supply and Assistance. For those that have chemical and material mixing capabilities, TRC works with a number of chemical suppliers to provide the treatment reagents and technical support for regulatory approval, mixing effectiveness, and trouble-shooting.

Remedial Design. TRC provides all aspects of engineering design from initial concept to detailed engineering.

TRC has worked on hundreds of sites impacted with heavy metals. Projects highlights are included on the following pages.

Table 3

Metals Remediation Projects

Client	Facility Type	Contaminant of Concern	Approving Agency	Project Description
AAA Property Rhode Island	Brownfields Redevelopment Project			— Treated 750 tons of arsenic-impacted soil using conventional construction equipment. Treated material was used for on-site backfill.
Armour Road Superfund Site Missouri	RR Pesticide formulation facility	Arsenic	USEPA Region 7	Conducted treatability study, supplied chemicals, and provided on-site assistance to treat an estimated 40,000 tons of contaminated soil.
Automobile Parts Manufacturer Indiana	Chrome Plating and Metals Manufacturing	Chromium	IDEM	Remediated approximately 9,000 tons of soil in situ. Reduced the chromium to an immobile form, which avoided RCRA hazardous waste permitting requirements. Resulted in cost savings of approximately $600,000 compared to traditional excavation alternatives. (#80089)
Automobile Parts Manufacturer Indiana	Chrome Plating and Metals Manufacturing		IDEM	Remediated residual chromium-impacted soil adjacent to building foundation in situ. Thirty-seven tons of chemicals were mixed with the first few feet of soil. Chromium was no longer detectable in the groundwater after approximately 150 days of treatment. (#80126)
Better Brite Wisconsin	Former Chrome Plating Facility	Chromium	WDNR	Stabilized over 15,000 cu. yds. of chromium-impacted clay soil in situ with a specialized mixing head attached to an excavator. Portions of the treated soil were below the water table. Soil was allowed to remain on-site after treatment.
Burnham Foundry Ohio	Foundry	Lead Cadmium	Ohio EPA	Treated 14,000 tons of soil in situ. (#2263)

Metals Treatment Technology

Metals Remediation Projects

Client	Facility Type	Contaminant of Concern	Approving Agency	Project Description
C and R Battery Virginia	Battery Recycling	Lead	USEPA	Remediated 38,000 cu. yd. of soil in situ. Saved the PRP group $300,000 compared to alternative technologies. (#70048)
C&D Landfill Pennsylvania	Various, including Battery Residuals	Lead	PADEP	Assisted with the treatment of over 50,000 tons of lead-impacted soil.
Cedar Rapids Police Department Gun Range Iowa	Firing Range	Lead		Stabilized 500 tons of lead-impacted soil, including screening bullets prior to treatment. (#5438)
Ceres Environmental Services, Brainerd Site Minnesota		Lead	COE	Provided chemical and technical support for in situ lead stabilization. (#3971)
CET Environmental, Fresno Drum Site California	Reclaimed Scrap Steel	Lead	CAEPA	Remediated 1,700 cu. yd. of soil in situ and rendered it non-hazardous to meet the California "wet test" criteria. (#90189)
City of Edina Shooting Range Minnesota	Shooting Range	Lead	MPCA	Treated approximately 2,000 cubic yards of soil in stockpiles ex situ with backhoes. Treated material was left on-site. (#4713)
City of Wausau – Bopf Street Wisconsin	Foundry Waste	Lead	WDNR	Remediated 1,200 cubic yards of material in situ on slope, then regraded to 3:1 and left on-site. (#4363)
City of Wisconsin Rapids Wisconsin	Scrap Yard	Lead	WDNR	Remediated 3,500 cu. yd. of soil in situ. Resulted in cost savings of over 75 percent compared to alternatives. (#10331)
Columbia Development Corp. South Carolina	Former Scrap Dealer	Lead	SCDHEC	Remediated over 500 tons of lead-impacted soil ex situ in a 2-week time frame. (#4820)
Confidential Client Australia	Copper Smelter	Lead Cadmium Arsenic Copper Selenium Zinc		Treated over 40,000 tons of smelter sludge. Treatment costs were less than half the cost of hazardous waste disposal. (#3973)

Metals Treatment Technology

Metals Remediation Projects

Client	Facility Type	Contaminant of Concern	Approving Agency	Project Description
Confidential Client Indiana	Foundry	Lead Cadmium	IDEM	Treated 69,000 cu. yd. of soil in situ and capped it on-site with USEPA and state approval. Resulted in client savings of approximately $15 million. (#1468)
Confidential Client Massachusetts		Arsenic	MADEP	Assisted with the stabilization of 1,500 tons of arsenic- and lead-contaminated soil above and below the groundwater table.
Confidential Client Ohio	Foundry	Lead	USEPA Region 5, Ohio EPA	Remediated 370,000 cu. yd. of sludge in-line using a continuous hydraulic dredging system. Received approval for continued use of the basin throughout the project saving the client $80-100 million compared with other remediation and disposal alternatives. (#20188)
Confidential Client Ohio	Foundry	Lead	Not Applicable	Stabilized 41,000 tons of settling basin waste underwater using a dragline. (#2140)
Confidential Client Southeastern U.S.	Former Manufacturing Facility	Lead Cadmium Chromium Zinc		Provided construction management for treatment of 30,000 tons of slag-affected soil. Treated over 60,500-ton batches in 5 weeks using TRC's proprietary lead stabilization additive, EnviroBlend®. Performed treatment at less than 90 percent of budget estimate. (#70227)
Confidential Client New Jersey	Former Fertilizer Mfg.	Lead Arsenic	NJDEP	Received agency approval for treatment of approximately 25,000 cu. yds. of soil. Treated material will be disposed on-site.
Conoco South Carolina	Former Fertilizer Mfg.	Lead Arsenic	SCDHEC, Region 4	Received approval for in-place treatment and on-site disposal of approximately 90,000 cu. yds. of soil and groundwater from a former fertilizer manufacturing facility to depths of 30 feet.
CWC Castings - Textron Michigan	Foundry	Lead Cadmium		Treated over 45,000 tons of sludge ex situ. Designed new wastewater treatment system to eliminate hazardous sludge generation. New wastewater and hazardous waste system saved the client $3 million in capital expenditures. (#122)
Diamond State Salvage Delaware	Former Salvage Yard	Lead	USEPA	Treated over 11,000 tons of lead-hazardous soil ex situ using EnviroBlend® at a former salvage yard.
Doberstein Lumber Wisconsin	Former	Arsenic	WDNR	TRC assisted with the stabilization of approximately 2,400 tons of soil contaminated with copper chromated arsenate (CCA). The treated material was left on-site.

Metals Treatment Technology

Metals Remediation Projects

Client	Facility Type	Contaminant of Concern	Approving Agency	Project Description
East Penn Manufacturing Pennsylvania	Battery Manufacturing	Lead	PADEP	Managed construction activities, including excavation, stabilization, placement, and structural compaction of over 30,000 tons of lead-contaminated soil and battery casings at an acid battery manufacturing plant.
EMR North Dakota	Salvage Yard – former battery cracking site	Lead	ND DOH	Preformed treatability study, and provided chemicals for treatment of 3,000 tons of lead-impacted soil. Saved client $120,000 in T & D costs alone.
Globe Valve Corp. Indiana	Foundry	Lead	IDEM	Designed waste treatment system with 2-year payback. Treated waste ex situ. Received 1989 Engineering Excellence Award from Wisconsin Assoc. of Consulting Engineers. (#1185)
GNB Technologies, Inc. Illinois	Battery Manufacturing	Lead	IEPA	Remediated 30,000 tons of soil in situ and ex situ. Received permission from IEPA to beneficially reuse the stabilized soil on-site through Illinois' Pre-Notice program. Use of TRC's stabilization chemistry and reuse of the soil on-site saved the client about $600,000 as compared to treatment with cement and hauling to a Subtitle D landfill. (#3083)
GNB Technologies, Inc. Georgia	Former Battery Manufacturer	Lead Cadmium Chromium	GA EPD	Stabilized 10,000 cubic yards of contaminated soil ex situ at a former battery manufacturing facility, now an operating chemical plant. (#70565)
Gopher Smelting & Refining Co. Minnesota	Smelter	Lead	MPCA	Remediated 2,650 tons of soil in situ. Resulted in significant cost savings as compared to hauling the soil as a hazardous waste or compared to other on-site treatments methods. (#3257)
Hennepin County Shooting Range Minnesota	Former Shooting Range	Lead	MPCA	Assisted with the in situ remediation of lead-impacted soil. (#4761)
Home Depot (Future Site) Pennsylvania	Former Shooting Range	Lead	PADEP	Remediated approximately 400 cu. yd. of lead-impacted soil in situ. (#4761)
LeMac Foundry Pennsylvania	Foundry Sand	Lead	PADEP	Rendered over 350 tons of lead-impacted soil nonhazardous using EnviroBlend®

Metals Treatment Technology

Metals Remediation Projects

Client	Facility Type	Contaminant of Concern	Approving Agency	Project Description
Marina Cliffs Barrel CERCLIS Site Wisconsin	Former Barrel Cleaning and Reconditioning	Chromium	USEPA Region 5; WDNR	Reduced TCLP-chromium from hazardous limits to near the detection limits. Stockpiled waste pit soil had been previously treated with cement to address other metals of concern. Treated 900 tons of soil ex situ that had a pH of 12. (#3949)
Mid-America Refinery Co. Kansas	Petroleum Refining	Lead	USEPA, Region 7	Assisted with the in situ treatment of approximately 20,000 tons of lead-impacted soil.
Minneapolis Community Development Agency Blocks 41 and 43 Minnesota	Former Scrap Yard	Lead	MPCA	Remediated 6,000 cu. yd. of debris using a pugmill ex situ, and a smaller amount of debris in situ. (#4375)
N. Chicago Vacant Lot (MACTEC, Inc.) Illinois	Foundry Debris Fill	Lead	Illinois EPA	Provided analytical support during the in situ remediation of approximately 10,000 tons of lead-contaminated soil.
Nahant Marsh Iowa		Lead		Assisted with treatment of over 7,500 tons of lead-impacted soil and sediment. (#4888)
National Vulcanized Fiber (NVF) Delaware	Fiber Board	Lead	DNREC	Treated over 1,600 cubic yards of lead-impacted soil in situ, leaving the treated material in-place next to a river.
New Haven Foundry Michigan	Foundry	Lead Cadmium Zinc	MDEQ	Remediated 12,700 cu. yd. of sediment in situ and an additional 5,200 cu. yd. of waste materials using a pugmill. (#1991)
NIBCO, Inc. New York	Foundry	Lead Cadmium	NYSDEC	Treated 6,000 cu. yd of soil. In situ treatment was completed with a Mobile Injection Treatment Unit (MITU). (#2778)
NPL Site South Carolina	Industrial Waste Disposal	Arsenic Cadmium Chromium Lead Mercury Nickel	USEPA	Provided full-time construction management oversight during stabilization/solidification of more than 57,000 cu. yd. of contaminated soil for a final cost of $7 million vs the preliminary cost estimate of $12-25 M based on USEPA data. (#673)
NVF Delaware	Fiber Board	Lead	DNREC	Treated over 1,600 cu. yds. of lead-impacted soil in situ using EnviroBlend®. The treated material was left in-place next to a river.

Metals Treatment Technology

Metals Remediation Projects

Client	Facility Type	Contaminant of Concern	Approving Agency	Project Description
Philotechnics Tennessee	Nuclear Weapons Manufacturing	Lead Cadmium Chromium	NRC	Provided analytical and chemical support to treat approximately 300 tons of low-level radioactive electric arc furnace dust in containers.
Prestolite New York	Automotive Mfg. Facility	Cadmium	NYSDEC	Treated 2,530 cu. yds. of cadmium-impacted soil. Mixed soil with a Mobile Injection Treatment Unit (MITU) in situ and left in-place.
Quakertown Foundry Pennsylvania	Foundry Sand	Lead	PADEP	Assisted with the treatment of approximately 40,000 tons of lead-impacted foundry sand.
Riley County Kansas	Battery Casings	Lead	KDHE	Provided construction management services for the in situ treatment and stabilization of 3,700 cu. yd. of soil impacted with lead from crushed batteries. (#4742)
Speakman Company Delaware	Foundry Sand	Lead	DNREC	Remediated approximately 1,100 cu. yd. of lead-impacted soil in situ. (#4811)
TapanAm Associates, Inc., Tru-Fit Battery Site Iowa	Battery Casings	Lead	Region 7	Assisted with treatment of 3,000 tons of lead-impacted soil. (#4870)
Texas Tempered Glass Texas	Glass Manufacturing	Lead	TNRCC	Remediated ~1,000 cu. yd. of lead-impacted soil in situ. (#4738)
Texon Polymer Texas	Plastic Flower Pots	Lead	TNRCC	A fire resulted in 2,000 cubic yards of melted flower pots. The material was ground with mechanical equipment, then treated ex situ.
Twin Cities Army Ammunition Plant Minnesota	Munitions Manufacturing	Arsenic Barium Lead	COE	Provided analytical support during the in situ remediation of approximately 5,000 tons of lead-contaminated soil. (#4761)
U.S. Army Corps of Engineers Minnesota	Residential Neighborhood with Foundry Waste	Lead	USEPA Region 5 COE MPCA	Remediated approximately 600 tons of foundry residue in situ with backhoes. (#3971)
U.S. Environmental Protection Agency Indiana	Former Porcelain Manufacturing	Lead Cadmium	USEPA Region 5, IDEM	Remediated 44,000 tons of soil in situ that was impacted with lead and cadmium from porcelain enameling grit. (#3994)

Metals Treatment Technology

Metals Remediation Projects

Client	Facility Type	Contaminant of Concern	Approving Agency	Project Description
U.S. Environmental Protection Agency Missouri	Lead Smelter/ Foundry	Lead	USEPA Region 7, MoDNR	Remediated 7,800 tons of soil in stockpiles ex situ using backhoe mixing. Dosage optimization reduced chemical usage by 50%. (#4336)
U.S. Environmental Protection Agency Wisconsin	Shooting Range	Lead	USEPA Region 5, WDNR	Remediated 500 tons of soil in situ using backhoes and roll-off containers. (#4290)
United Retek Massachusetts		Arsenic	MADEP	Assisted with the stabilization of 1,500 tons of arsenic- and lead-contaminated soil above and below the groundwater table.
Waite Park Minnesota		Lead	MPCA	Assisted with the stabilization of over 25,000 tons of soil. (#5415)
Wausau Steel Wisconsin	Battery and Scrap Recycling	Lead	WDNR	Treated 3,000 cu. yd. of material in situ and consolidated on-site within 100-year flood plain. Used SPLP to demonstrate groundwater protection. (#3929)
Wisconsin Department of Transportation	Bridge Reconstruction Site	Lead	WDNR	Remediated over 500 tons of sediment in situ underwater within a coffer dam in a navigable waterway. (#10249)
Wisconsin Dept. of Natural Resources	Orchards	Lead Arsenic	WDNR	Remediated soil in situ at apple and cherry orchards. (#1068)
Wisconsin Dept. of Transportation	Former Battery Cracking Facility	Lead	WDNR	Remediated 55,000 cu. yd. of battery reclaiming residue in situ using conventional construction equipment, including some material below the water table. Demonstrated groundwater protection and left the treated material on-site. (#10001)

TRC's treatment reagents have been successfully implemented at over 40 metals facilities.

SECTION 3

In-Plant Treatment of Industrial Waste

TRC treatment reagents can be incorporated directly into your process stream to stabilize heavy metals before the point of waste generation. This means that you can eliminate the need for a hazardous waste permit and, in many cases, by-pass RCRA regulations entirely.

Where treatment prior to the point of hazardous waste generation is not logistically possible, the reagent can also be used to treat wastes in tanks or containers. If treatment occurs within 90 days of waste generation, treatment permits are usually not required.

Clear Benefits

Preventing waste from becoming hazardous offers clear benefits. Not only is it possible to then by-pass the time and expense of meeting RCRA permitting requirements, but also the treated material can be disposed of on-site or at a landfill permitted to accept nonhazardous waste. This cuts transportation and disposal costs, while at the same time reducing environmental impact.

Proven Effective. TRC's technologies have been used to successfully treat over 100 waste streams at over 40 industrial plants across the United States. Since first developed in 1989, the technologies have been used to treat over two million tons of hazardous waste for a wide range of industries. That includes wet and dry wastes in both batch and in-line continuous feed processes.

Reduced Costs. When total costs are compared, TRC's reagents offer significant savings over solidification chemicals. That's due to the slower dose, minimal bulking, and simple application methods. TRC customers also save considerable amounts of time, effort, and money by avoiding the RCRA permitting requirements.

Easy Application. Many facilities take advantage of the ease of use of TRC's reagents and employ a variety of mixing techniques in both dry and wet environments. For dry wastes, such as emission control dusts, the reagent can be added as a dry powder. The optimum method is to inject the dry powder into the ductwork prior to the baghouse, which will generally prevent the generation of a hazardous waste. For wet scrubbers, the reagent can be added to the clarifier, or at another convenient point, prior to the filter or sludge dewatering unit.

Regulatory Acceptance

Treatment with TRC reagents, such as EnviroBlend®, is widely accepted by regulators for use in treatment systems. In-plant treatment is currently approved for use by regulators in 18 states for the facilities listed in Table 4. In most of the facilities, the feed system is installed before the baghouse, eliminating the need to manage the waste as a hazardous material.

Table 4

EnviroBlend® In-Plant Projects

Client	Location	Production Type
Acme Foundry	Coffeyville, KS	Gray Iron
American Bronze Corp	Cleveland, OH	Bronze
Bronze Craft Corp.	Nashua, NH	Aluminum/Brass/Bronze
Charlotte Pipe & Foundry	Charlotte, NC	Gray Iron
Dalton Corporation	Kendallville, IN	Gray Iron
Dalton Corporation	Warsaw, IN	Gray Iron
Deeter Foundry	Lincoln, NE	Gray Iron
Doe Run	Boss, MO	Lead Smelting
East Jordan Iron Works	Denham Springs, LA	Ductile/Gray Iron
Ford Meter Box Co. Inc.	Wabash, IN	Brass/Bronze
Globe Valve	Delphi, IN	Brass/Bronze
Golden Casting	Columbus, IN	Gray Iron
Great Lakes Castings	Muskegon, MI	Gray Iron
Harrison Steel Castings Co.	Attica, IN	Duct Iron/Steel
Lufkin Industries	Lufkin, TX	Ductile/Gray Iron
Lynchburg Foundry Co.	Lynchburg, VA	Ductile Iron
Magotteaux	Pulaski, TN	Steel
Milwaukee Valve	Milwaukee, WI	Brass/Bronze
Sloan Valve Company	Augusta, AR	Brass/Bronze
U.S. Pipe And Foundry	Burlington, NJ	Ductile Iron
U.S. Pipe And Foundry	Birmingham, AL	Ductile Iron
U.S. Pipe And Foundry	Bessemer, AL	Ductile Iron
Wabash Alloys	Dixon, TN	Aluminum
Wabash Alloys	E. Syracuse, NY	Aluminum

Metals Treatment Technology

EnviroBlend® In-Plant Projects		
Client	**Location**	**Production Type**
Wabash Alloys	Wabash, IN	Aluminum
Wabash Alloys	Haskell, AR	Aluminum
Wabash Alloys	Oak Creek, WI	Aluminum
Waupaca Foundry	Tell City, WI	Duct/Gray Iron
Waupaca Foundry	Waupaca, WI	Ductile/Gray Iron
Wheland Foundry	Chattanooga, TN	Ductile/Gray Iron
Wheland Foundry	Warrenton, GA	Ductile/Gray Iron

TRC's patented treatment technologies have successfully treated hundreds of heavy metals-impacted sites.

SECTION 4

Remediation Examples for Specific Metals

Effective remediation requires the ability to characterize site conditions using a combination of tools. Proper sampling, an understanding of the metal's chemistry, properly performing treatability tests, data interpretation, and modeling are critical to identifying the most cost-effective remediation approach. Addressing impacted sites in the most cost-effective manner can save millions in remediation dollars. TRC applies a solution-focused approach to hazardous substance site remediation projects. This involves the upfront integration of risk evaluation, long-term land use preferences, and overall site objectives into the remedial approach.

TRC has extensive knowledge of fate and transport of heavy metal contamination, as well as remedial action know-how. TRC will systematically and objectively evaluate all feasible commercially available treatment technologies. In addition, our scientists have spent years developing cost-effective means for rendering heavy metal contaminants nonhazardous, including arsenic. This research has resulted in a number of patented products that have been widely applied to heavy metal remediation sites across the country.

Properly performing treatability tests is a critical component in identifying the most cost-effective remediation approach. TRC has worked on hundreds of sites impacted with heavy metals. The following projects highlight our expertise with impacted sites.

Insert appropriate metals project sheets as required, i.e., arsenic, chromium, lead.